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Dietzen

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[54] **OIL AND GAS WELL CUTTINGS DISPOSAL SYSTEM**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 729,872, Oct. 15, 1996, which is a continuation-in-part of Ser. No. 416,181, Apr. 4, 1995, Pat. No. 5,564,509, which is a continuation-in-part of Ser. No. 197,727, Feb. 17, 1994, Pat. No. 5,402,857.

[51] **Int. Cl.**[6] **F21B 21/06**; B09B 5/00

[52] **U.S. Cl.** **175/66**; 175/206; 175/207

[58] **Field of Search** 175/66, 206, 207; 166/267; 134/108

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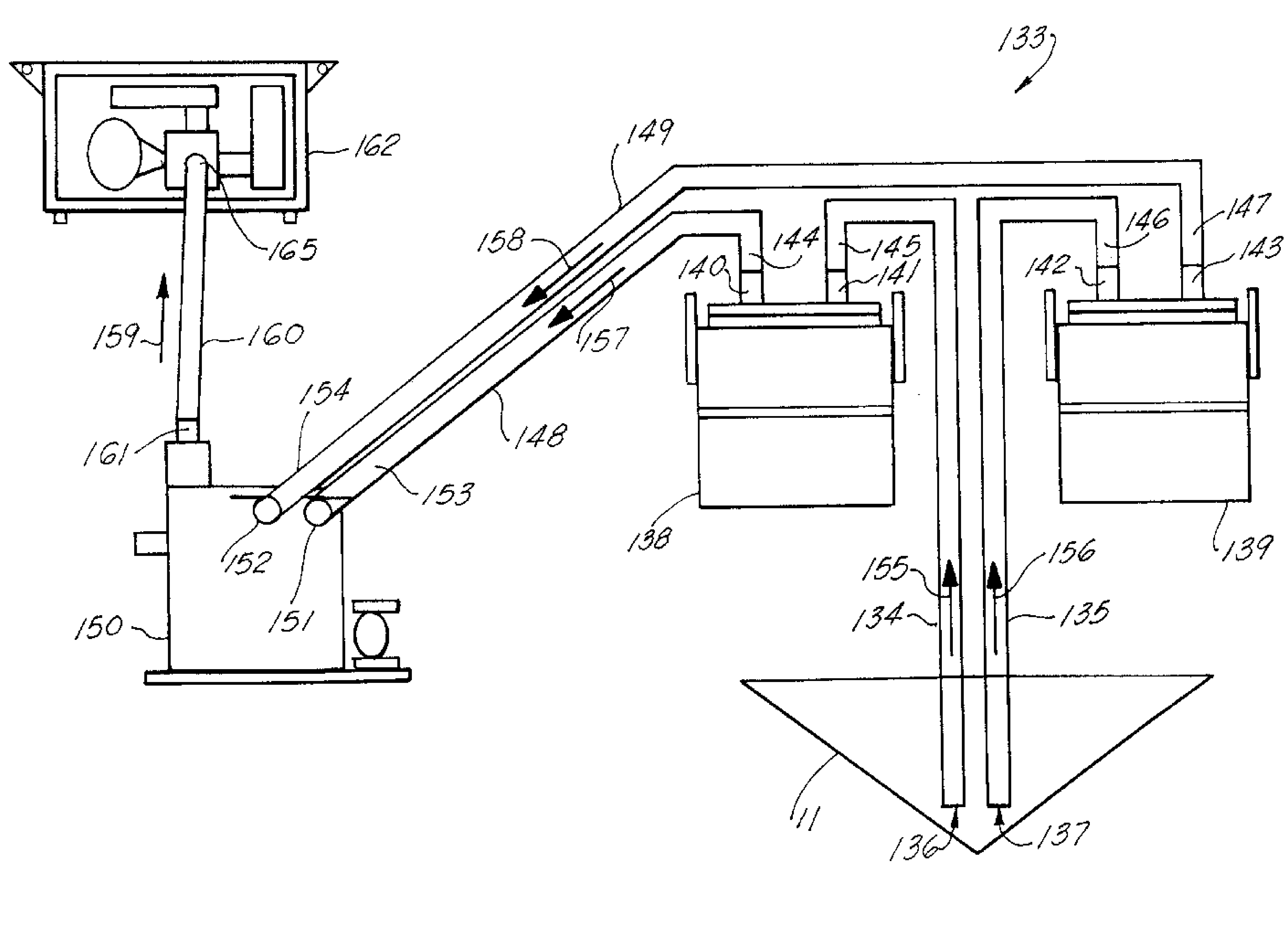
Primary Examiner—Frank Tsay

Attorney, Agent, or Firm—Garvey, Smith, Nehrbass & Doody, L.L.C.

[57] **ABSTRACT**

A method of removing drill cuttings from an oil and gas well drilling platform includes the steps of separating the drill cuttings from the well drilling fluid on the drilling platform so that the drilling fluids can be recycled into the well bore during drilling operations. The cuttings are then transmitted via gravity flow to a materials trough having an interior defined by sidewalls and a bottom portion. The drill cuttings are suctioned from the bottom portion of the trough interior with a pair of primary suction lines, each having an intake portion that is positioned at the materials trough bottom. Drill cuttings are transmitted via the primary suction lines at flow velocities in excess of 100 feet per second to a pair of collection tanks that each have an interior. A vacuum is formed in sequence within the interior of each tank using a blower that is in fluid communication with the tank interior via a vacuum tank and secondary suction lines.

25 Claims, 8 Drawing Sheets



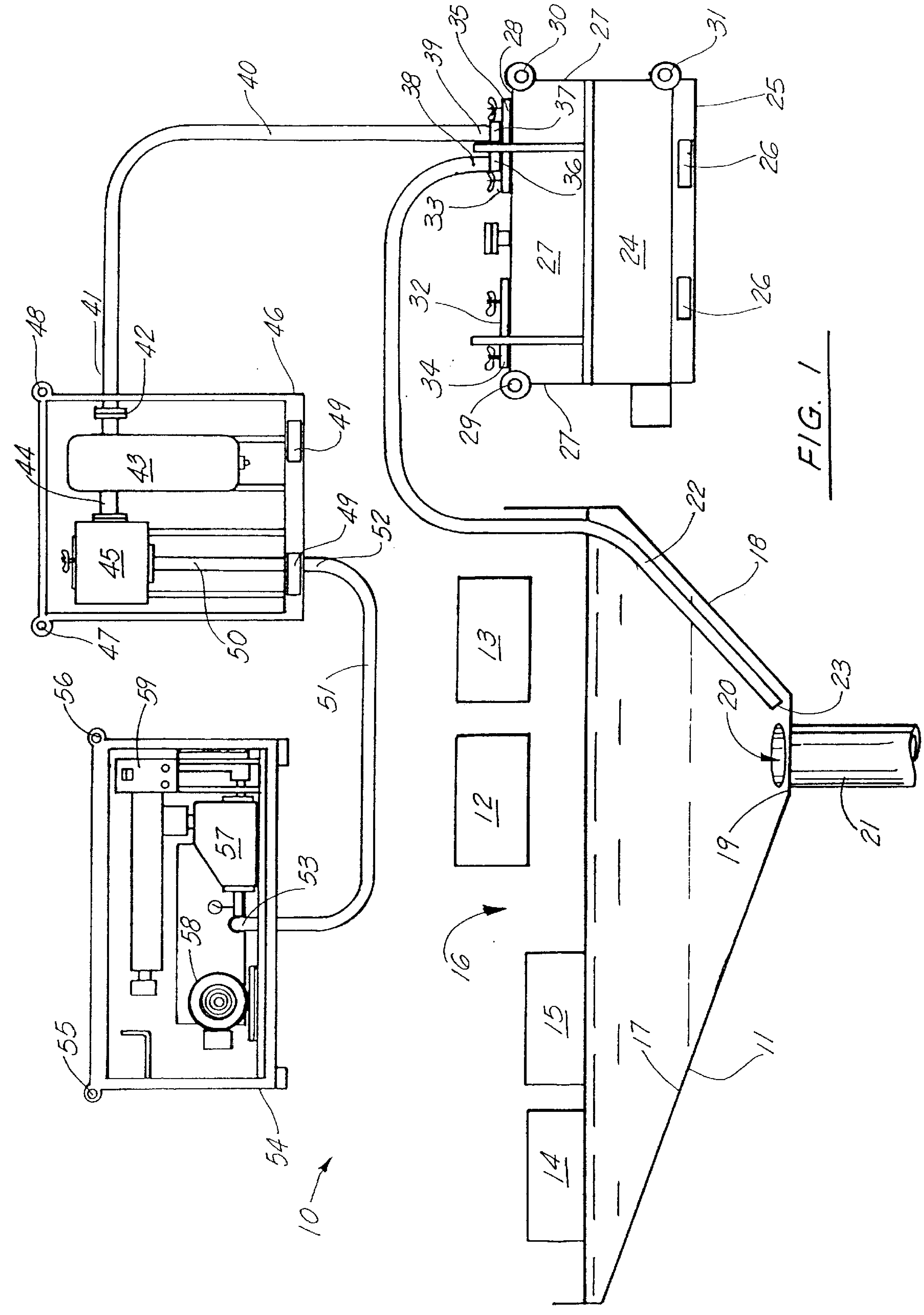


FIG. 1

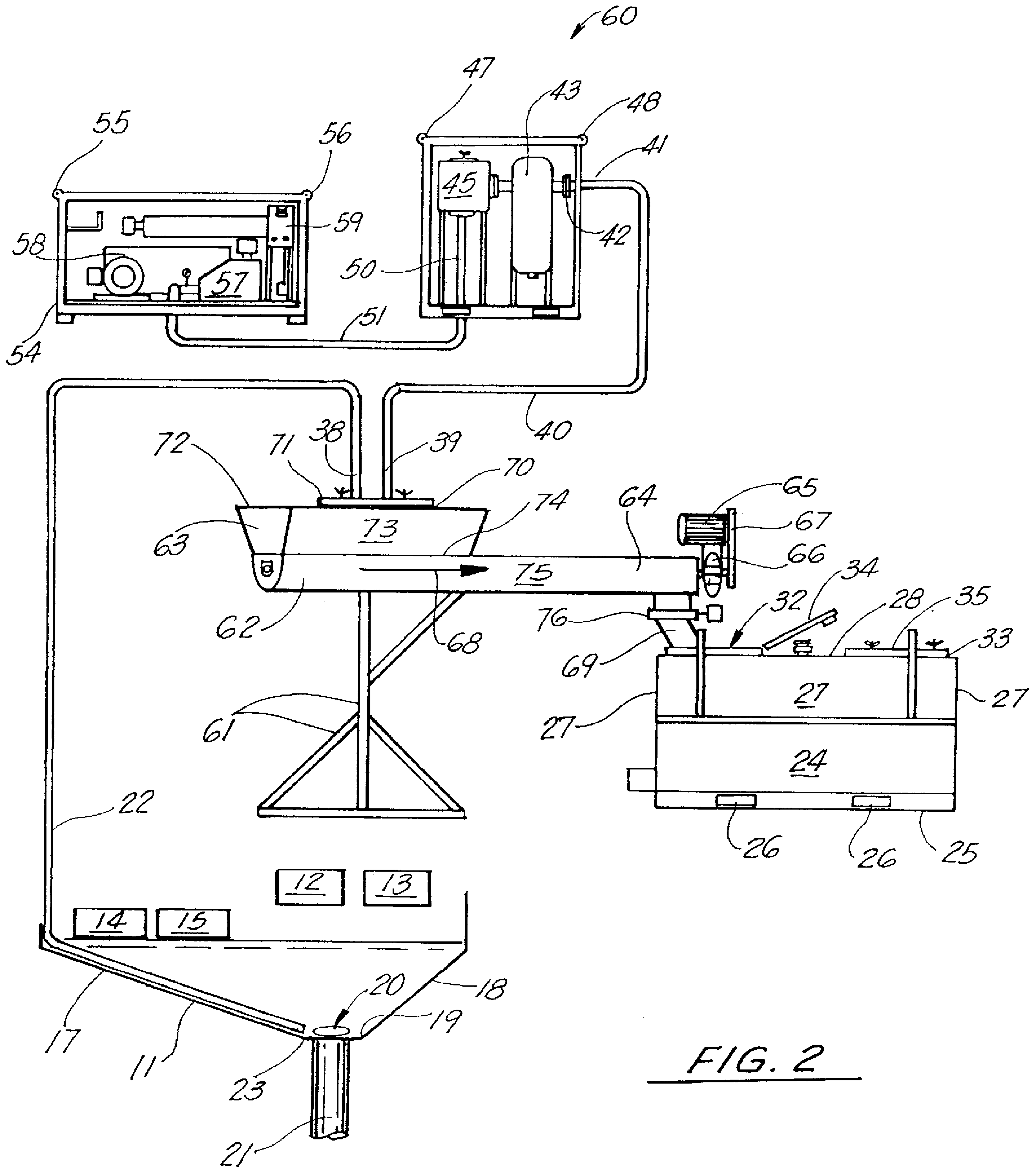

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FIG. 2

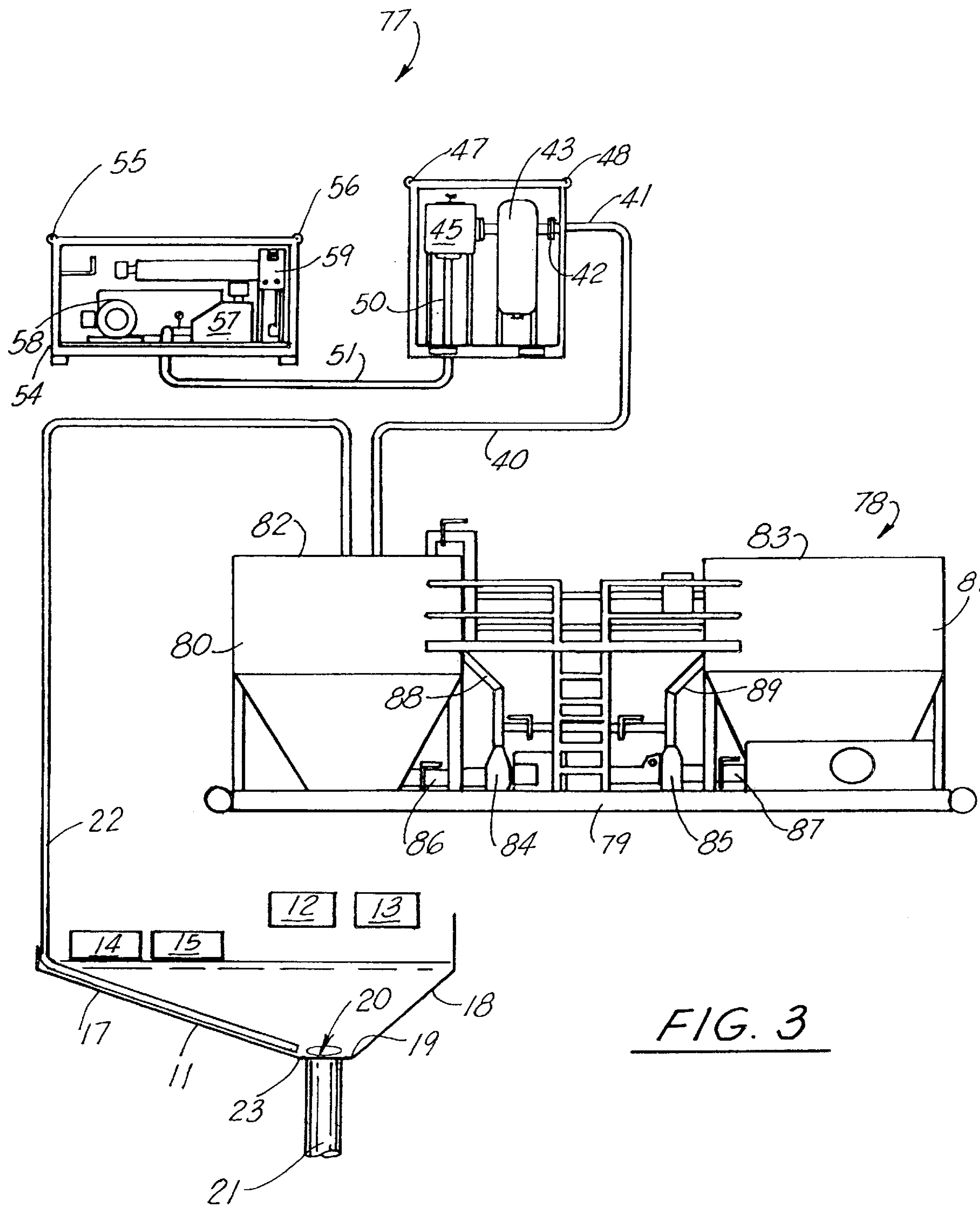
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FIG. 3

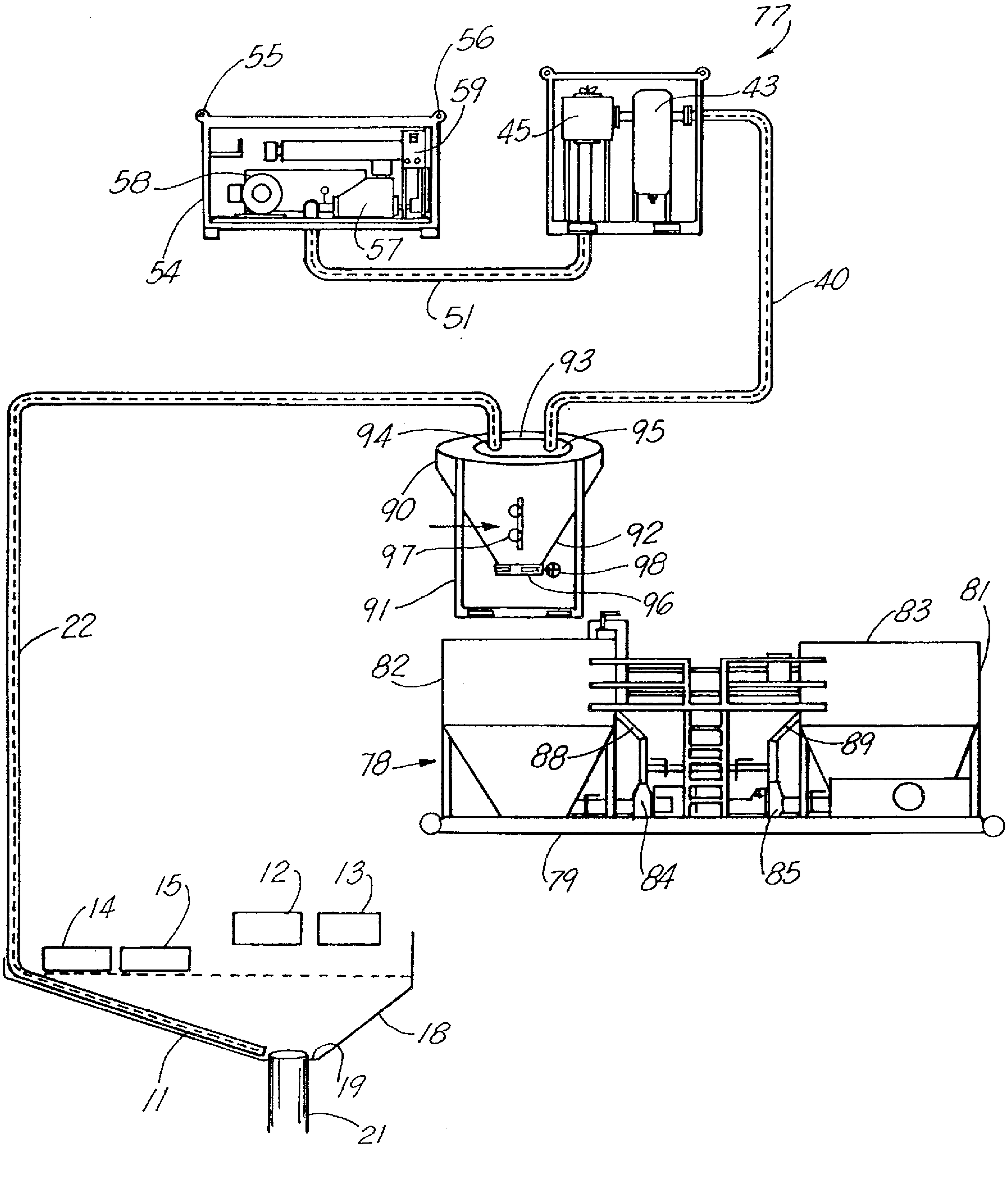
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FIG. 4

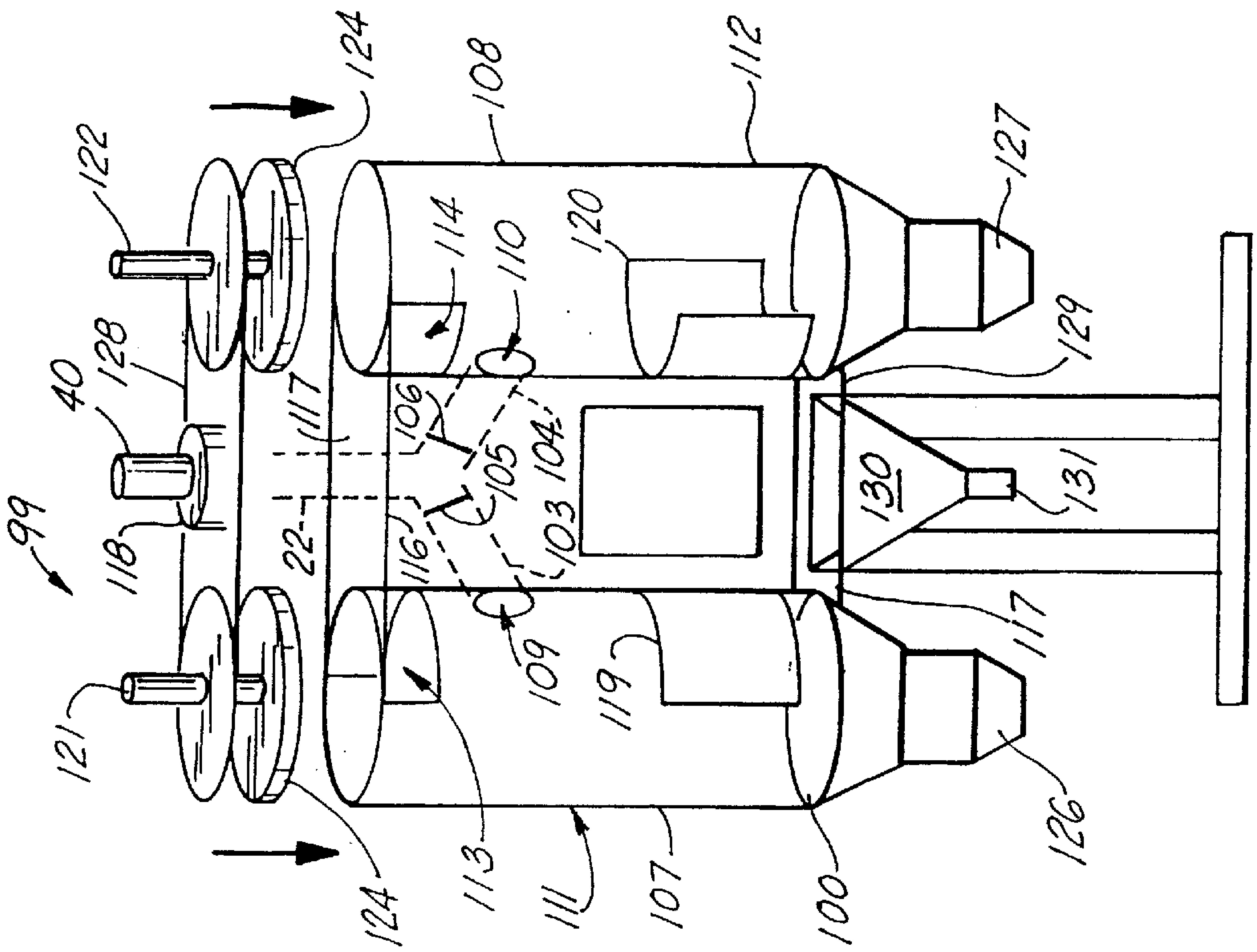
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FIG. 5

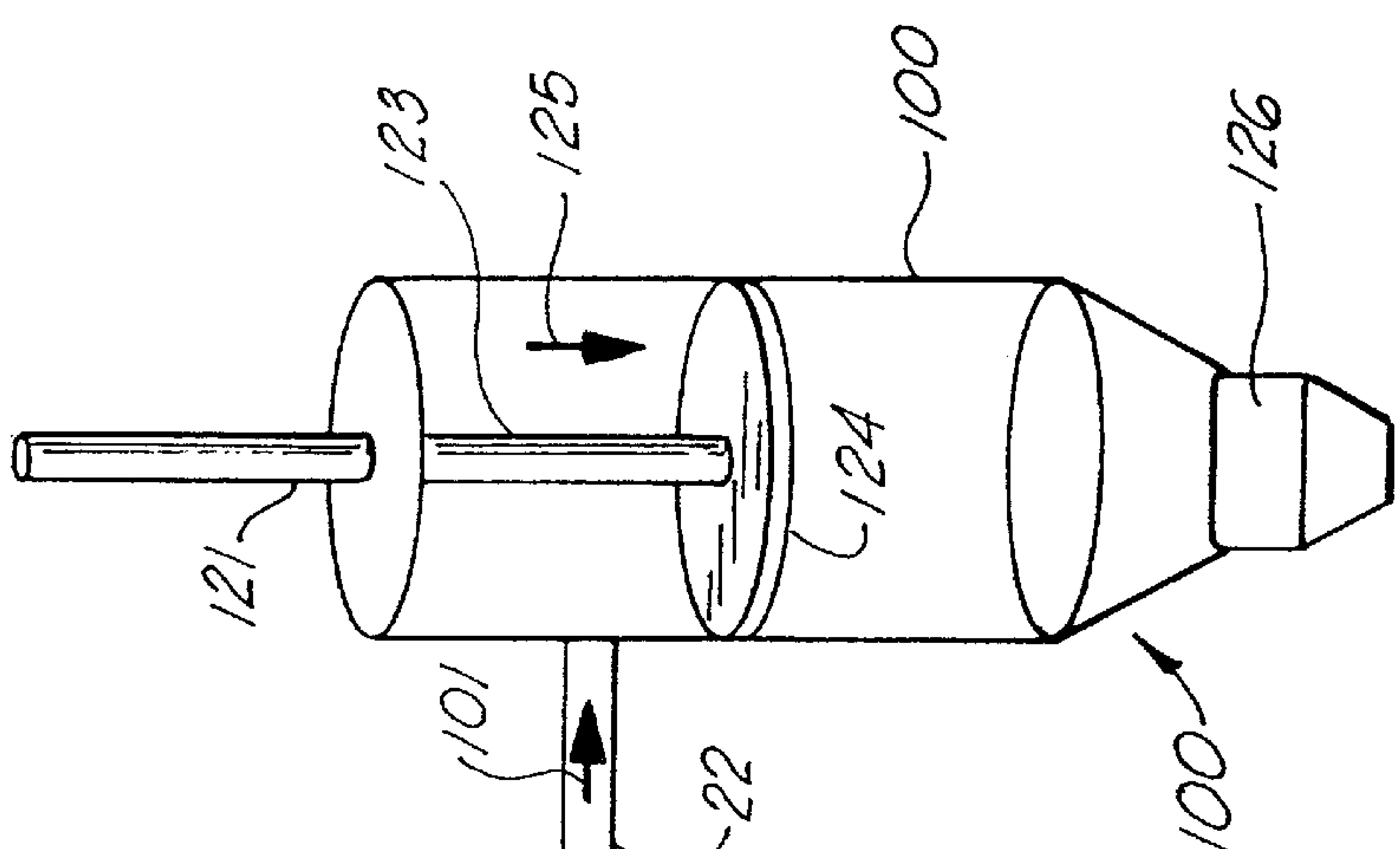
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FIG. 6

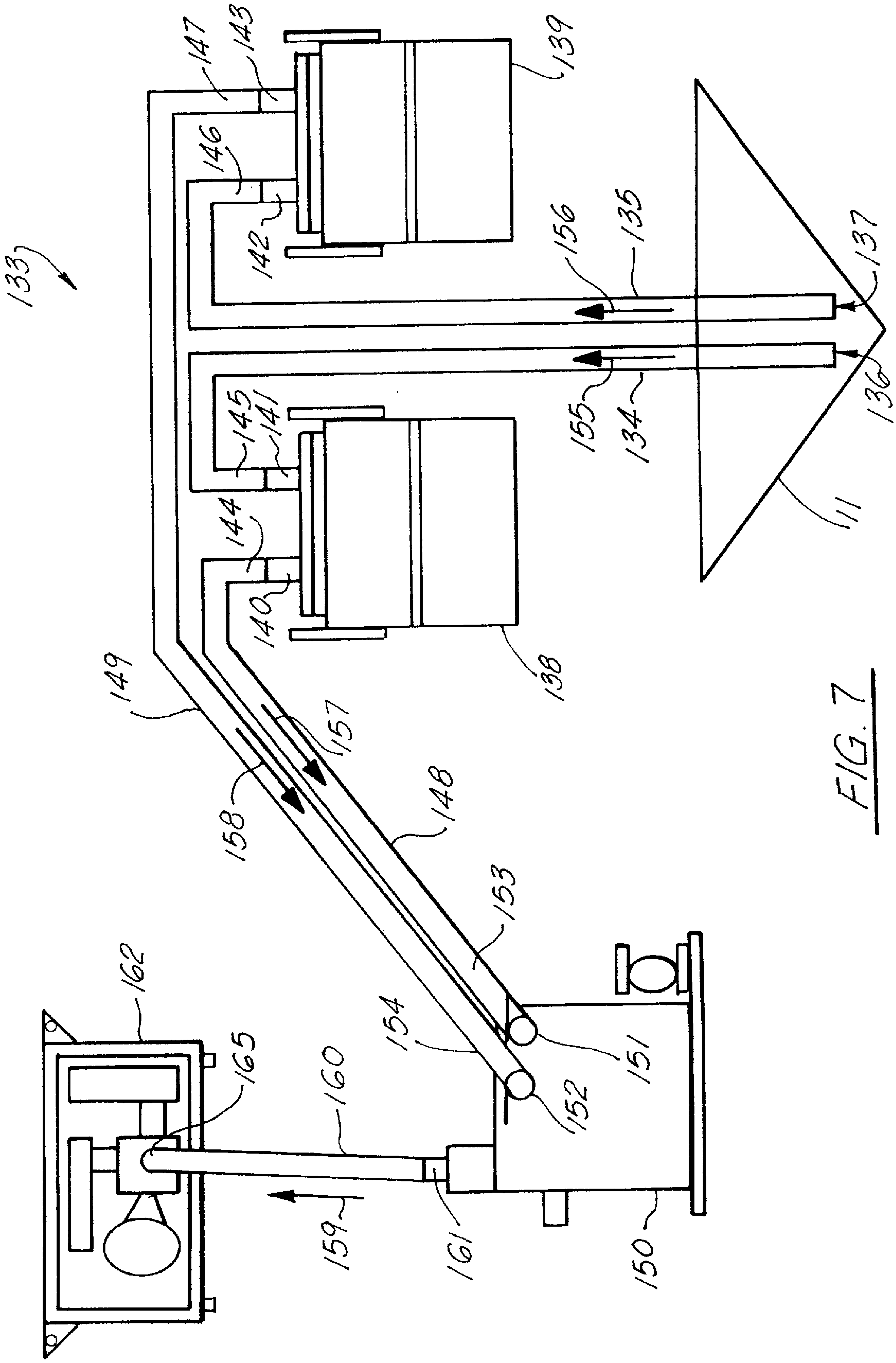
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FIG. 7

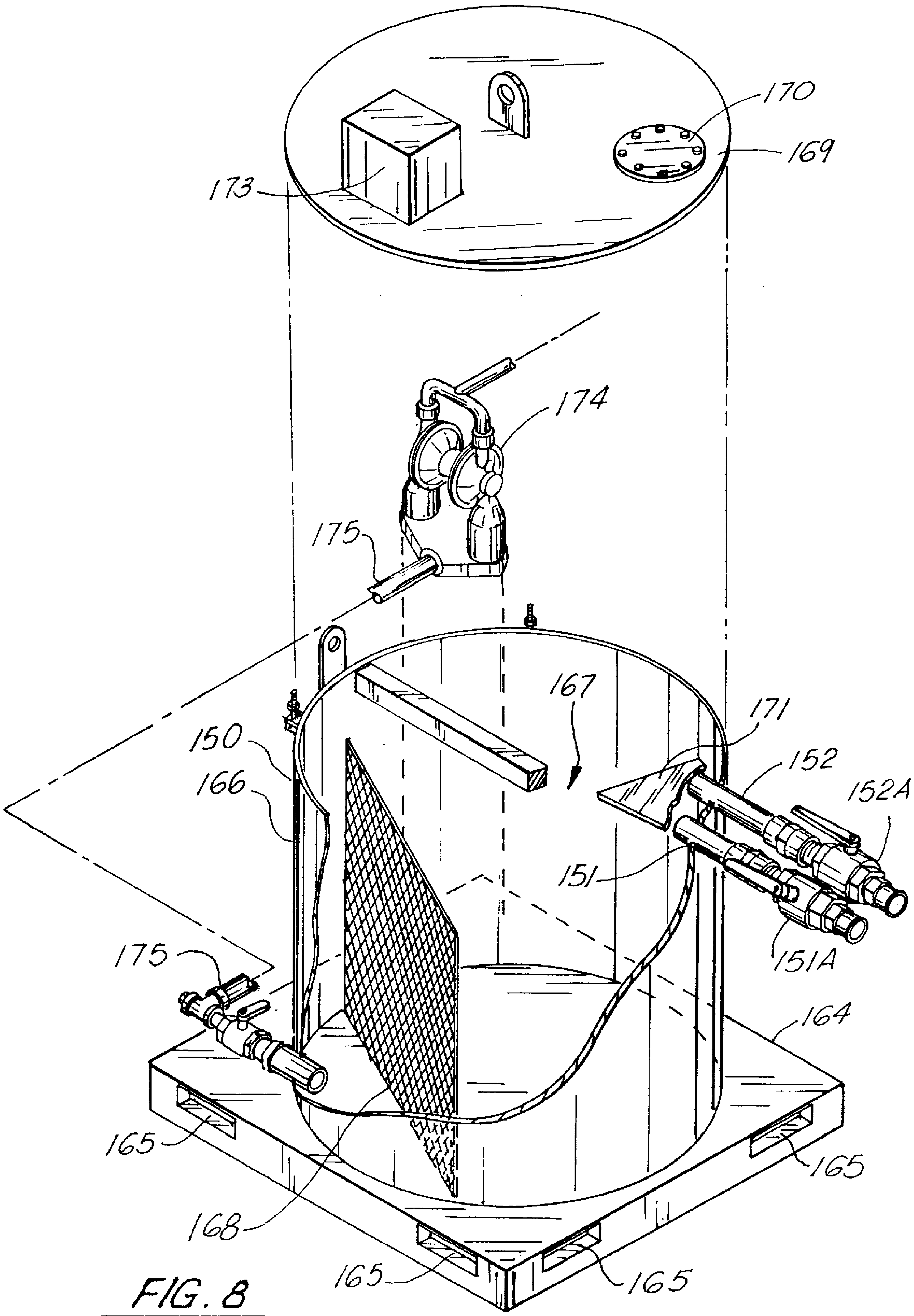
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FIG. 8

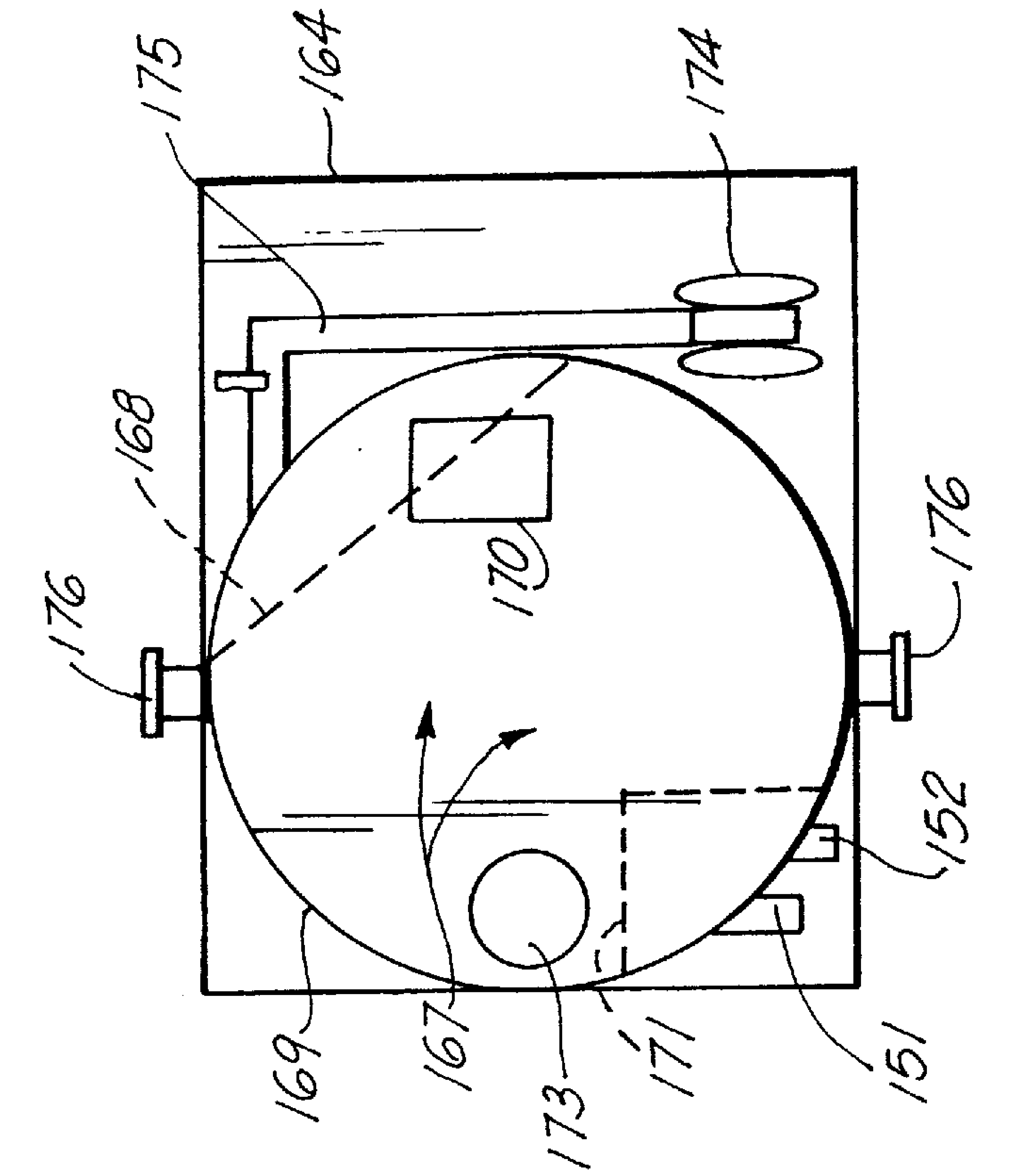
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FIG. 10

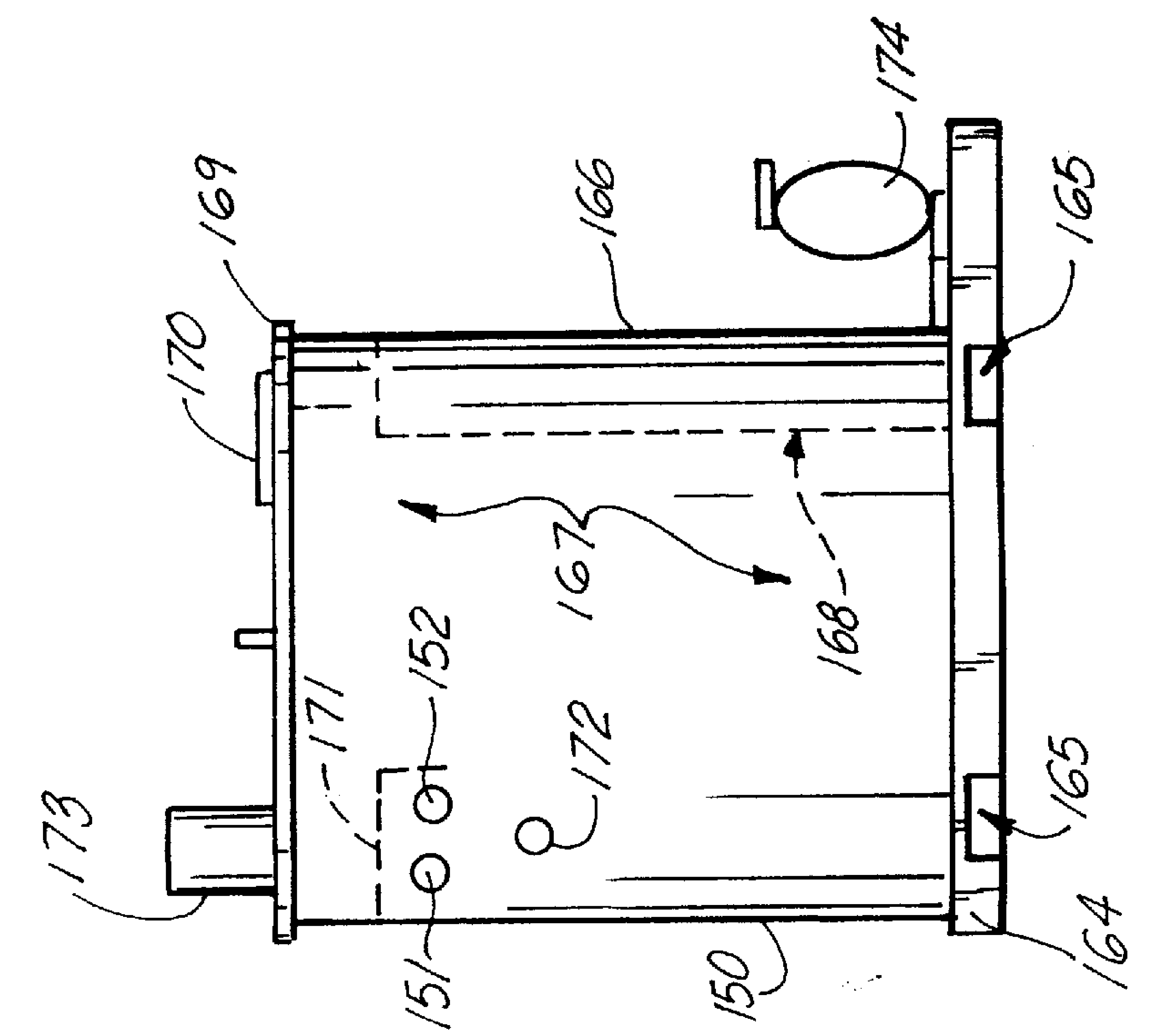
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FIG. 9

OIL AND GAS WELL CUTTINGS DISPOSAL SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation-in-part of U.S. patent application Ser. No. 08/729,872, filed Oct. 15, 1996, which is a continuation-in-part of U.S. patent application Ser. No. 08/416,181, filed Apr. 4, 1995 (now U.S. Pat. No. 5,564,509) which is a continuation-in-part of U.S. patent application Ser. No. 08/197,727, filed Feb. 17, 1994 (now U.S. Pat. No. 5,402,857), each of which is incorporated herein by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable

REFERENCE TO A "MICROFICHE APPENDIX"

Not applicable

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the disposal of oil and gas well cuttings such as are generated during the drilling of an oil and gas well using a drill bit connected to an elongated drill string that is comprised of a number of pipe sections connected together, wherein a fluid drilling mud carries well cuttings from the drill bit through a well annulus and to a solids removal area at the well head for separating well cuttings from the drilling mud. Even more particularly, the present invention relates to an improved well cuttings disposal system that collects oil and gas well cuttings in a transportable tank that is subjected to a vacuum and which two chambers alternatively and sequentially receive cuttings and separate drilling mud from the cuttings for recycling.

2. General Background

In the drilling of oil and gas wells, a drill bit is used to dig many thousands of feet into the earth's crust. Oil rigs typically employ a derrick that extends above the well drilling platform and which can support joint after joint of drill pipe connected end to end during the drilling operation. As the drill bit is pushed farther and farther into the earth, additional pipe joints are added to the ever lengthening "string" or "drill string". The drill pipe or drill string thus comprises a plurality of joints of pipe, each of which has an internal, longitudinally extending bore for carrying fluid drilling mud from the well drilling platform through the drill string and to a drill bit supported at the lower or distal end of the drill string.

Drilling mud lubricates the drill bit and carries away well cuttings generated by the drill bit as it digs deeper. The cuttings are carried in a return flow stream of drilling mud through the well annulus and back to the well drilling platform at the earth's surface. When the drilling mud reaches the surface, it is contaminated with these small pieces of shale and rock which are known in the industry as well cuttings or drill cuttings.

Well cuttings have in the past been separated from the reusable drilling mud with commercially available separators that are know as "shale shakers". Some shale shakers are designed to filter coarse material from the drilling mud while other shale shakers are designed to remove finer particles from the well drilling mud. After separating well

cuttings therefrom, the drilling mud is returned to a mud pit where it can be supplemented and/or treated prior to transmission back into the well bore via the drill string and to the drill bit to repeat the process.

The disposal of shale and cuttings is a complex environmental problem. Drill cuttings contain not only the mud product which would contaminate the surrounding environment, but also can contain oil that is particularly hazardous to the environment, especially when drilling in a marine environment.

In the Gulf of Mexico for example, there are hundreds of drilling platforms that drill for oil and gas by drilling into the subsea floor. These drilling platforms can be in many hundreds of feet of water. In such a marine environment, the water is typically crystal clear and filled with marine life that cannot tolerate the disposal of drill cuttings waste such as that containing a combination of shale, drilling mud, oil, and the like. Therefore, there is a need for a simple, yet workable solution to the problem of disposing of oil and gas well cuttings in an offshore marine environment and in other fragile environments where oil and gas well drilling occurs. Traditional methods of cuttings disposal have been dumping, bucket transport, cumbersome conveyor belts, and washing techniques that require large amounts of water. Adding water creates additional problems of added volume and bulk, messiness, and transport problems. Installing conveyors requires major modification to the rig area and involves many installation hours and very high cost.

SUMMARY OF THE INVENTION

The present invention provides an improved method and apparatus for removing drill cuttings from an oil and gas well drilling platform that uses a drill bit supported with an elongated, hollow drill string. Well drilling fluid (typically referred to as drilling mud) that travels through the drill string to the drill bit during a digging of a well bore.

The method first includes the step of separating well drilling fluid from the waste drill cuttings on the drilling platform so that the drilling fluid can be recycled into the well bore during drilling operations. The drill cuttings fall via gravity from solid separators (e.g. shale shakers) into a material trough. At the material trough, cuttings are suctioned with an elongated suction line having an intake portion positioned in the materials trough to intake well cuttings as they accumulate. In the preferred embodiment, two suction lines are provided. Each suction line has an intake that is positioned to suction cuttings from the materials trough. Each suction line communicates with a cuttings collection tank. A third tank (i.e. a vacuum tank) is positioned in between the vacuum source and the two collection tanks that communicate with the two materials collection lines. The third tank has dual inlets, each receiving a flow line from a respective collection tank. Each inlet is valved so that either one of the collection tanks can be shut off from the vacuum source. In this fashion, one collection tank can be filled at a time. The two collection tanks can be sequentially filled without having to shut the vacuum source down.

The drill cuttings are transmitted via a selected one of the suction lines to a selected one of the collection tanks.

A vacuum is formed within the selected collection tank interior using a blower that is in fluid communication with the tank interior.

Liquids (drilling mud residue) and solids (well cuttings) are separated from the vacuum line at the selected collection tank before the liquids and solids can enter the blower.

The blower is powered with an electric motor drive to reach a vacuum of between about sixteen and twenty-five inches of mercury. Each vacuum line is sized to generate speeds of between about one hundred and three hundred feet per second.

BRIEF DESCRIPTION OF THE DRAWINGS

For a further understanding of the nature and objects of the present invention, reference should be had to the following detailed description, taken in conjunction with the accompanying drawings, in which like parts are given like reference numerals, and wherein:

FIG. **1** is a schematic view of the first embodiment of the apparatus of the present invention;

FIG. **2** is a schematic view of a second embodiment of the apparatus of the present invention;

FIG. **3** is a schematic view of a third embodiment of the apparatus of the present invention;

FIG. **4** is a schematic view of the third embodiment of the apparatus of the present invention illustrating the use of a hopper tank in combination with the slurry unit;

FIG. **5** is an elevational front view of a fourth embodiment of the apparatus of the present invention that utilizes a cuttings squeezer in combination with a vacuum system;

FIG. **6** is a side elevational view of the fourth alternate embodiment of the apparatus of the present invention;

FIG. **7** is a schematic view of a fifth embodiment of the apparatus of the present invention;

FIG. **8** is a fragmentary perspective view of the fifth embodiment of the apparatus of the present invention illustrating the rig vacuum tank portion thereof;

FIG. **9** is a fragmentary side, elevational view of the fifth embodiment of the apparatus of the present invention illustrating the rig vacuum tank portion thereof; and

FIG. **10** is a top fragmentary view of the fifth embodiment of the apparatus of the present invention illustrating the rig vacuum tank portion thereof.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. **1**, there can be seen a first embodiment of the well cuttings disposal system **10** of the present invention. Well cuttings disposal system **10** is used in combination with a material trough that collects solids falling via gravity from a plurality of solids separator units. Material troughs per second are known in the art, typically as a catch basin for cuttings. The material trough **11** defines an area that is a receptacle for solids containing some residual drilling mud. Cuttings have been collected from the well bore after the drilling mud has been transmitted through the drill string to the drill bit and then back to the surface via the well annulus.

At the material trough, there are a plurality of coarse shakers **12, 13** and a plurality of fine shakers **14, 15**. The shakers **12, 13**, and **14, 15** are commercially available. Coarse shakers **12, 13** are manufactured under and sold under the mark "BRANDT" and fine shakers are sold under the mark "DERRICK". Shakers **12–15** channel away the desirable drilling mud to a mud pit. The well cuttings fall via gravity into trough **11**. It is known in the prior art to channel away drilling mud that is to be recycled, and to allow well cuttings to fall from shale shakers via gravity into a receptacle. Such as been the case on oil and gas well drilling rigs for many years.

Interior **16** of trough **11** catches cuttings that have fallen from shakers **12, 15**. The trough **11** thus defines an interior **16** having a plurality of inclined walls **17, 18** that communicate with a trough bottom **19**. Walls **17, 18** can be Teflon covered to enhance travel of material to bottom **19**.

Trough bottom **19** includes a discharge opening **20** that communicates with discharge conduit **21**. The opening **20** is typically sealed during operation with a closure plate (not shown).

A first suction line **22** is positioned to communicate with the interior **16** portion of trough **11**. First suction line **22** thus provides an inlet **23** end portion and an opposite end portion that communicates with collection tank **24**. Tank **24** collects solid material and some liquid (e.g., residual drilling mud on the cuttings) as will be described more fully hereinafter.

Collection tank **24** has a bottom **25**, a plurality of four generally rectangular side walls **27**, and a generally rectangular top **28**. A pair of spaced apart fork lift sockets **26** allow tank **24** to be lifted and transported about the rig floor and to a position adjacent a crane or other lifting device.

A plurality of lifting eyes **29, 31** are provided including eyes **29, 30** on the top of tank **24** and lifting eye **31** on the side thereof near bottom **25**.

The lifting eyes **29** and **30** are horizontally positioned at end portions of the tank top **28**. This allows the tank to be lifted with a crane, spreader bar, or other lifting means for transferral between a marine vessel such as a work boat and the drilling rig platform. In FIG. **1**, the tank **24** is in such a generally horizontal position that is the orientation during use and during transfer between the rig platform and a remote location on shore, for example.

The lifting eyes **30, 31** are used for emptying the tank **24** after it is filled with cuttings to be disposed of. When the tank is to be emptied, a spreader bar and a plurality of lifting lines are used for attachment to lifting eyes **30, 31**. This supports the tank in a position that places lifting eye **29** and lifting eye **30** in a vertical line. In this position, the hatch **34** is removed so that the cuttings can be discharged via gravity flow from opening **30** and into a disposal site.

During a suctioning of well cuttings from materials trough **11**, the suction line **22** intakes cuttings at inlet **23**. These cuttings travel via line **22** to outlet **38** which communicates with coupling **36** of tank **24**. Flow takes place from inlet **23** to outlet **38** because a vacuum is formed within the hollow interior of tank **24** after hatches **34, 35** are sealed. The vacuum is produced by using second suction line **40** that communicates via separators **43, 45** with third suction line **51** and blower **57**.

Second suction line **41** connects at discharge **39** to coupling **37** of hatch **35**. The opposite end of suction line **40** connects at end portion **41** via coupling **42** to fine separator **43**. A second fines separator **45** is connected to separator **43** at spool piece **44**. The two separators **43** and **45** are housed on a structural separator skid **46** that includes lifting eyes **47, 48** and fork lift sockets **49** for transporting the skid **46** in a manner similar to the transport of tank **24** as aforedescribed.

Third suction line **51** connects to effluent line **50** that is the discharge line from separator **45**. End portion **52** of third suction line **51** connects to effluent line **50** at a flange, removable connection for example. The three suction lines **22, 40, 51** are preferably between three and six inches in internal diameter, and are coupled with blower **57** generating about 300–1500 CFM of air flow, to generate flow desired velocities of about 100–300 feet per second that desirably move the shale cuttings through suction line **22**. The suction lines are preferably flexible hoses of oil resistant PVC or can be Teflon coated rubber. Quick connect fittings are used to connect each suction line at its ends.

End portion **53** of third section line **51** also connects via a flanged coupling, for example, to blower **57**. Blower **57** and its motor drive **58** are contained on power skid **54**. Power skid **54** also includes a control box **59** for activating and deactivating the motor drive **58** and blower **57**. The power skid **54** provides a plurality of lifting eyes **55, 56** to allow the power skid **54** to be transported from a work boat or the like to a well drilling platform using a lifting harness and crane that are typically found on such rigs.

Each of the units including tank **24**, separator skid **46**, and power skid **54** can be lifted from a work boat or the like using a crane and transported to the rig platform deck which can be for example 100 feet above the water surface in a marine environment.

In FIG. **2**, a second embodiment of the apparatus of the present invention is disclosed, designated generally by the numeral **60**. In FIG. **2**, the tank **24** is similarly constructed to that of the preferred embodiment of FIG. **1**. However, in FIG. **2**, the well cuttings disposal system **60** includes a support **61** that supports a screw conveyor **62** and its associated trough **63**. The trough **63** and screw conveyor **62** are sealed at opening **70** in trough **63** using hatch **71**. Trough **63** is positioned at an intake end portion of screw conveyor while the opposite end portion of screw conveyor **62** provides a discharged end portion **64** that communicates with discharge shoot **69**. Chute **69** empties into opening **32** when hatch **34** is open during use, as shown in FIG. **2**.

The screw conveyor **62** is driven by motor drive **65** that can include a reduction gear box **66** for example, and a drive belt **67**. Arrow **68** in FIG. **2** shows the flow path of coarse cuttings that are discharged via first suction lines **22** into opening **70** and trough **63**. The sidewall and bottom **74** of trough **63** communicate and form a seal with screw conveyor outer wall **75** so that when a vacuum is applied using second suction line **40**, cuttings can be suctioned from trough **11** at intake **23** as with the preferred embodiment. The conveyor **62** forcibly pushes the drill cuttings toward discharge end **64**. A spring activated door **76** is placed in chute **69**. When material backs up above door **76**, the door quickly opens under the weight of cuttings in chute **69**. Once the cuttings pass door **76**, the door shuts to maintain the vacuum inside trough **73**, and screw conveyor **62**, thus enabling continuous vacuuming.

In FIG. **3** there can be seen a third embodiment of the apparatus of the present invention designated generally by the numeral **77**. Well disposal cutting system **77** substitutes a slurry unit **78** for collection tank **24** of FIG. **1**. Slurry unit **78** has a liftable base frame **79** of welded steel, for example. Upon the frame **79** are positioned a pair of spaced apart vessels **80, 81**. Each vessel **80, 81** has a top into which well cuttings can be suctioned in a manner similar to the way in which well cuttings are suctioned into collection tank **24** with the embodiment of FIG. **1**. The vessel tops **82, 83** respectively can be provided with openings for connecting the flow lines **22–40** thereto as with the embodiments of FIGS. **1** and **2**. The slurry unit **28** provides pumps with impellers (e.g., Mission Magnum fluid centrifugal pump with 75 hp electric motor—5" discharge, 6", suction) for breaking up the cuttings continuously until they form a slurry with a liquid such as water, for example. Pumps **84, 85** have suctioned flow lines **86, 87** respectively and discharge lines **88, 89** respectively. The discharge lines **88, 89** can be seen communicating with the upper end portion of each of the vessels **80, 81** respectively. Likewise, the suction lines **86, 87** communicate with the lower end portion of each of the vessels **80, 81** respectively.

Using the method and apparatus of FIG. **3**, a desired volume of cuttings can be suctioned into either one or both of the vessels **80, 81**. The pumps **84, 85** are equipped with impellers that can chop up the cuttings into even finer pieces. For example, the pump impellers can have carbide tips that are effective in chopping up and pulverizing the cuttings until a slurry is formed. Each pump **84, 85** respectively continuously recirculates the slurry of cuttings and water between the pump **84, 85** and its respective vessel **80, 81** until a thick viscous slurry is created. A triplex pump (e.g., Gardner Denver) and piping (not shown) can then be used for transmitting the slurried cuttings from the respective vessels **80, 81** downhole, into the well annulus, usually between 2000'–5000' for example, into a porous zone such as a sand zone. In this fashion, the cuttings are disposed of by deep well disposal at the drill site rather than transporting the cuttings to a remote cite such as on shore in the case of a marine based platform.

In FIG. **4**, a hopper tank **90** is shown in combination with the slurry unit **78**. Hopper **90** is an optional unit that can be used to receive cuttings from first suction line **22** and to collect the cuttings for batch discharge into slurry unit **78** at intervals. As with the embodiment of FIG. **1**, the hopper tank **90** provides a rectangular or circular lid **93** with openings **94, 95** that respectively communicate with vacuum lines **22** and **40**.

Hopper tank **90** is preferably supported with a structural liftable frame **91**. The tank **90** has a conical wall **92**. The upper end portion of tank **90** provides the circular lid **93** while the lower end portion of tank **90** has a discharge outlet **96** controlled by valve **98**. Air vibrators **97** can be attached to the conical wall **92** for insuring a complete and smooth discharge of cuttings from within the interior of the hollow hopper tank **90**.

FIGS. **5** and **6** show a fourth embodiment of the apparatus of the present invention designated generally by the numeral **99**. In the embodiment of FIGS. **5** and **6**, the apparatus shown functions in combination with suction components of FIG. **1** or FIG. **2**. In the embodiment of FIGS. **5** and **6**, the tank **24** of FIG. **1** is replaced with the cuttings squeezer **100** including its collection cylinders **107, 108**, liquid hopper **117**, and the associated piping.

In this fashion, the suction line **22** of FIG. **1** communicates with an inlet in the form of a way fitting **102** that carries cuttings from flow line **22** to the way fitting **102** of FIGS. **5** and **6**.

The vacuum line **40** of FIGS. **1** and **2** functions as an outlet flow line for suction that communicates with an uppermost outlet fitting **118** on liquid hopper **117**.

In the embodiment of FIGS. **5** and **6**, the drill cuttings squeezer **100** would thus be used in conjunction with the vacuum system components of FIGS. **1**. Instead of material being vacuumed directly into a cutting tank **24** as with FIG. **1** however, material would be suctioned from the cutting trough **11** via flow line **22** to drill cuttings squeezer **100** as shown by arrow **101** in FIG. **5**. The vacuum flow line **40** would communicate with outlet fitting **118** of drill cuttings squeezer **100**. In the embodiment of FIGS. **5** and **6**, the drill cuttings squeezer **100** replaces the tank **24** of FIG. **1**.

Way fitting **102** has a pair of branch lines **103, 104** each of which carries a valve **105, 106**. Valves **105, 106** can be for example power operated ball valves such as electrically operated or air operated ball valves.

Each branch line **103, 104** communicates with a collection chamber or cylinder **107, 108** respectively. Openings **109, 110** in the collection chamber **107, 108** respectively allow material to flow via line **22** to way fitting **102** and then to either branch line **103** or **104** depending upon which of the ball valves **105, 106** is open or closed.

The valves would preferably be set on automatic timers so that once a particular collection chamber **107** or **108** is full, the valves **105, 106** switch positions to direct material to the other chamber that is not full. When a chamber is full, a hydraulic ram associated with each cylinder pushes material downward and out of the discharge end. Each of the collection chambers **108, 109** is comprised of a cylindrically shaped hollow cylinder having outer wall **111, 112** respectively to provide a hollow interior for holding material that is conveyed to the cylinders **107, 108** via the way fitting **102** and branch lines **103, 104**.

At the lower end of each collection cylinder **107, 108** there is provided a screen **119, 120** respectively so that liquid (i.e. drilling fluid) mixed with the drill cuttings can be separated to flow through the screen **119** or **120** into liquid hopper **117**. At the upper end of each cylinder **107, 108** a curved air return outlet **113, 114** through the collection cylinder wall **111** or **112** that provides a return line for suction that communicates with outlet fitting **118** and flow line **40**.

The liquid hopper **117** thus provides a pair of opposed rectangular plates **115, 116** that can be welded to the wall **111, 112** of the cylinders **107, 108** to form an enclosure in between the cylinders **107, 108**. Welded steel plates also seals the hopper **117** at the top and at the bottom. Outlet fitting **118** is an outlet fitting on an upper plate member **128**. Likewise, a lower plate **129** carries funnel **130**.

At the bottom of the liquid hopper **117**, there is provided funnel portion **130** and a liquid outlet **131**. In this fashion, liquid can be removed after it has been separated from the cuttings using the hydraulic rams **121, 122** and screen **119, 120** associated with the cylinders **107, 108**.

The operation of a single hydraulic ram **121** is shown in FIG. **6**. The ram **121** includes a pushrod **123** and a circular plate **124** that fits snugly against the cylindrically shaped wall **111** of collection cylinder **107**. As the hydraulic driven ram **121** is operated to force pushrod **123** downwardly in the direction of arrow **125**, material below the circular disk **124** is pushed toward the check valve **126**. Each of the tanks **107, 108** similarly provides a pushrod **123**, circular plate **124**, and outlet check valve **126** or **127**. The check valve **126, 127** are preferably rubber-like check valves that are commercially available from Red Valve Company for example.

During use, material such as drill cuttings, some drilling mud and the like would be directed into one cylinder **107, 108** or another cylinder **107** or **108** sequentially so that the material could be continuously suctioned via line **22** without having to shut the apparatus down. The valves **105, 106** and hydraulic cylinders **121, 122** would preferably be set on automatic timers so that when a chamber **107** or **108** is full of material, the valves **105, 106** would be either opened or closed to direct material to the other chamber that would be empty. The chambers **107, 108** thus alternate between empty and full condition, one chamber filling is filling while the other is being emptied.

After the material was then directed to the empty chamber, the hydraulic ram **121** or **122** associated with that chamber would begin to push material downward and out of the discharge end via the check valve **126** or **127**. As the drill cuttings material and associated drilling fluid is pushed down, it will be compacted and excess fluid squeezed through the screen **119** or **120**. Each screen **119** or **120** can be removable and of a selected mesh size depending upon the particular application.

Fluid which passes through a screen **119** or **120** would drain into the hermetically sealed tank **117**. Tank **117** is preferably fabricated for example by welding the plates **115** and **116** to opposing sides of the cylinders **107, 108** as shown in FIG. **5** and by similarly welding plates **128, 129** at the top and bottom respectively of the collection cylinders **107, 108** to form an enclosure. In this fashion, the only inlet and outlet on the drill cutting squeezer **100** would be inlet line **22** that communicates with trough **11** and suction outlet line **40** that communicates with separators **43** and **45**.

Fluid would drain into the funnel or sump **131** of liquid hopper **117**. This collected drilling fluid could then be pumped with a diaphragm pump to transfer the drilling fluid back to the active drilling fluid system of the rig for recycling. Once the hydraulic ram **121** or **122** has pushed material completely out of collection chamber **107** or **108** in the direction of arrow **132**, a hydraulic cylinder attached to pushrod **123** would return disk **124** to its upper, starting position at the top of the cylinder **107** or **108** to await the redirecting of material into the cylinder via the branch lines **103, 104** and the openings **109, 110**.

In FIGS. **7–10**, the fifth and preferred embodiment of the apparatus of the present invention is designated generally by numeral **133**. Well cutting disposal system **133** employs two suction lines **134, 135** in the embodiment of FIGS. **7–9**. The two suction lines **134, 135** each provide respective inlet portions **136, 137** for intaking well cuttings and associated material that fall into trough **11**. Trough **11** would be constructed in accordance with the description of FIG. **1**. Thus, trough **11** can include material separation equipment such as coarse shakers, fine shakers and the like. The shakers channel away desirable drilling mud to a mud pit. The well cuttings fall via gravity, for example, into trough **11**.

As with the embodiment of FIG. **1**, it is known in prior art to channel away drilling mud that is to be recycled and to allow well cuttings to fall from shale shakers, and like separating equipment via gravity into a receptacle such as trough **11**. The interior of trough **11** catches cuttings that have fallen from shale shakers and like equipment.

In FIGS. **7–9**, the inlet portions **136, 137** occupy the interior of trough **11**. This enables either inlet portion **136** or **137** to vacuum cuttings that have fallen into the interior of trough **11**. The embodiment of FIG. **1** used a single suction line to remove cuttings from the interior of trough **11**. In FIG. **7**, two suction lines are used, each with its own collection tank.

In FIG. **7**, a pair of collection tanks **138, 139** are provided, each receiving well cuttings that are suctioned with respective suction lines **134, 135**. Each collection tank **138, 139** provides fittings for forming connections with end portions of the primary suction lines **134, 135** and with end portions of secondary suction lines **148, 149**.

An end portion **145** of suction line **134** forms a connection at inlet fitting **141** with end portion **145**. Similarly, inlet fitting **142** forms a connection with end portion **146** of primary suction line **135**. Secondary suction line **148** forms a connection at its end portion **144** with outlet fitting **140**. Similarly, secondary suction line **149** forms a connection at its end portion **147** with outlet fitting **143**. The secondary suction lines **148, 149** form connections at their respective end portions **153, 154** with inlet fittings **151, 152** of rig vacuum tank **150**.

Vacuum tank **150** provides an outlet fitting **161** for connection of tertiary suction line **160** thereto. Line **160** conveys air to vacuum skid **162** as shown by the arrow **159** in FIG. **7**. The vacuum skid **162** is constructed in accordance with the embodiment of FIGS. **1–6**, including for example a blower that is powered with an electric motor to reach a vacuum of between sixteen and twenty-five inches of mercury. In FIG. **1**, such a vacuum skid unit is designated as **154** and includes a control box **59** for activating and deactivating the motor drive **58** and blower **57**. Vacuum skid **162** can thus be constructed in accordance with power skid **54** in the embodiment of FIG. **1**.

During use, the vacuum skid **162** generates a vacuum that communicates with flow line **160** and thus the interior of tank **150**. The presence of a vacuum in tank **150** also produces a vacuum in the primary suction lines **134, 135,** collection tanks **138, 139,** and in the secondary vacuum lines **148, 149**. This vacuum produces a suction at inlets **136** and **137** for transmitting cuttings and like material contained in trough **11** to collection tanks **138, 139** via the respective primary suction lines **134, 135**. This travel of well cuttings and like material from trough **11** to collection tanks **138** and **139** is indicated by the arrows **155, 156** in FIG. **7**.

Material traveling from trough **11** to collection tank **138** travels in primary suction line **134** and enters collection tank **138** at inlet fitting **141**. The collection tank **138** communicates with its outlet fitting **140** with secondary suction line **148** and inlet fitting **151** of vacuum tank **150**. When tank **138** fills, some material may flow in the direction of arrow **157** from tank **138** into vacuum tank **150**. However, the vacuum tank **150** has a level sensor **172** that shuts off vacuum skid **162** should the level of material in tank **150** reach the sensor **172** which is positioned at a level just below inlets **151, 152**. In this fashion, neither liquid nor solid material can reach vacuum skid **162**.

In practice, the collection tanks **138, 139** are filled in an alternating, sequential fashion. This is made possible by valves **151**A, **152**A that are respectively placed at fittings **151, 152**. The operator simply closes the valve at fitting **152** when the valve at **151** is open and tank **138** is being filled. This closure of a valve at fitting **152** shuts off any vacuum from secondary flow line **149** and primary flow line **135** to tank **139**. Thus the tank **138** preliminarily fills until the valve **152**A at fitting **152** is opened and the valve **151**A at fitting **151** is closed.

In this manner, an operator can continuously suction cuttings from trough **11**. This is important when well drilling activity is at a peak and the trough **11** is receiving a continuous flow of cuttings from shale shakers and like equipment. By alternating the vacuum to tank **138** or tank **139**, the well cuttings disposal system **133** of the present invention can function continuously. When a tank **138** or **139** is filled, suctioning simply switches to the other tank so that the filled tank **138** or **139** can be removed and a new tank can be put in its place. If fluid or other material in tank **150** reaches sensor **172**, the vacuum skid **162** can be automatically shut off. However, the sensor **172** can also operate a diaphragm discharge pump **174** for emptying the contents of vacuum tank **150**.

FIGS. **8–10** show more particularly the construction of rig vacuum tank **150**. Tank **150** has a base **164** with a pair of space-to-part sockets **165** for receiving fork lift tines that can lift and transport tank **150**. The tank **150** has a cylindrical wall **166** with a hollow tank interior **167**. Screen **168** is placed on the inside **167** of tank **150** and functions to prevent debris from getting into diaphragm discharge pump **174**. Tank **150** has a removable lid **169** that carries an inspection hatch **170** and a separator **173**. The entire lid **169** is removable for easy cleaning of tank **150** should such cleaning be required.

Separator **173** removes any fluids in the air stream that flows through lines **160** to vacuum skid **162**. Deflector plate **171** is positioned on the inside **167** of tank **150** for deflecting material that enters tank interior **167** via inlet fittings **151, 152**. Discharge pump **174** communicates with tank interior via flow line **175**.

The following table lists the parts numbers and parts descriptions as used herein and in the drawings attached hereto.

PARTS LIST

Part Number	Description
10	well cuttings disposal system
11	material trough
12	coarse shaker
13	coarse shaker
14	fine shaker
15	fine shaker
16	reservoir
17	inclined wall
18	inclined wall
19	trough bottom
20	discharge opening
21	conduit
22	first suction line
23	inlet
24	collection tank
25	bottom
26	fork lift socket
27	side wall
28	top
29	lifting eye
30	lifting eye
31	lifting eye
32	opening
33	opening
34	hatch
35	hatch
36	coupling
37	coupling
38	outlet
39	discharge
40	second suction line
41	end
42	coupling
43	separator
44	spool piece
45	separator
46	separator skid
47	lifting eye
48	lifting eye
49	fork lift socket
50	effluent line
51	third suction line
52	end
53	end
54	power skid
55	lifting eye
56	lifting eye
57	blower
58	motor drive
59	control box
60	well cuttings disposal system
61	support
62	screw conveyor
63	trough
64	discharge end portion
65	motor drive
66	gearbox
67	drive belt
68	arrow
69	discharge chute
70	opening
71	hatch
72	top
73	side wall
74	bottom
75	screw conveyor outer wall
76	spring loaded door

-continued

PARTS LIST

Part Number	Description
77	well cuttings disposal unit
78	slurry unit
79	frame
80	vessel
81	vessel
82	top
83	top
84	pump
85	pump
86	flow line
87	flow line
88	flow line
89	flow line
90	hopper tank
91	liftable frame
92	conical wall
93	circular lid
94	opening
95	opening
96	outlet
97	air vibrator
98	valve
99	cutting system
100	drill cuttings squeezer
101	arrow
102	wipe fitting
103	branch line
104	branch line
105	valve
106	valve
107	collection cylinder
108	collection cylinder
109	inlet opening
110	inlet
111	wall
112	wall
113	opening
114	opening
115	plate
116	plate
117	liquid hopper
118	outlet fitting
119	screen
120	screen
121	ram
122	ram
123	pushrod
124	circular plate
125	arrow
126	check valve
127	check valve
128	upper plate member
129	lower piate member
130	funnel
131	outlet
132	arrow
133	well cuttings disposal system
134	primary suction line
135	primary suction line
136	inlet portion
137	iniet portion
138	collection tank
139	collection tank
140	outlet fitting
141	inlet fitting
142	inlet fitting
143	outlet fitting
144	end portion
145	end portion
146	end portion
147	end portion
148	secondary suction line
149	secondary suction line
150	rig vacuum tank
151	inlet
151A	valve

-continued

PARTS LIST

Part Number	Description
152	inlet
152A	vaive
153	end portion
154	end portion
155	arrow
156	arrow
157	arrow
158	arrow
159	arrow
160	flow line
161	outlet fitting
162	vacuum skid
163	inlet fitting
164	base
165	socket
166	cylindrical wall
167	tank interior
168	screen
169	lid
170	inspection hatch
171	deflector plate
172	fluid level sensor
173	separator
174	discharge pump
175	flow line
176	lifting eye

Because many varying and different embodiments may be made within the scope of the inventive concept herein taught, and because many modifications may be made in the embodiments herein detailed in accordance with the descriptive requirement of the law, it is to be understood that the details herein are to be interpreted as illustrative and not in a limiting sense.

What is claimed as invention is:

1. A method of removing drill cuttings from an oil and gas well drilling platform that uses a drill bit supported with a drill string and a well drilling fluid during a digging of a well bore, comprising the steps of:

a) separating drill cuttings from the well drilling fluid on the drilling platform so that the drilling fluids can be recycled into the well bore during drilling operations;

b) transmitting the cuttings to a materials trough having an interior;

c) suctioning the separated drill cuttings with a suction line having an intake end portion that can be positioned at the materials trough;

d) transmitting the drill cuttings via the suction line to a pair of tanks that each have an interior and at least one access opening for communicating with the tank interior;

e) sequentially forming a vacuum within the holding tank interiors with a blower that is in fluid communication with each tank interior; and

f) using a third tank to selectively control the vacuum within the tank interiors.

2. The method of claim **1** wherein in step "d", the third tank has two valve portions and wherein the holding tank interior portions are filled and emptied in an alternating sequence by controlling the valves.

3. The method of claim **1** wherein the flow velocity in the suction line is about one hundred to three hundred (100–300) feet per second.

4. The method of claim **1** further comprising the step of separating residual drilling fluid from drill cuttings within the holding tanks.

5. The method of claim **1** wherein liquids and solids are separated from the suction line at the holding tank and liquids and solids are separated from the second suction line at the third tank positioned in fluid communication with a second vacuum line upstream of the blower.

6. The method of claim **1** wherein the blower generates fluid flow in the vacuum lines of between about three hundred and fifteen hundred (300–1500) cubic feet per minute.

7. The method of claim **1** wherein the vacuum formed within each holding tank is between about sixteen and twenty-five (16–27) inches of mercury.

8. An oil well drill cuttings disposal apparatus comprising:

a) a pair of holding tanks for collecting drill cuttings to be disposed of, each of said tanks having an interior collection chamber, each with a holding tank inlet opening that allows material to be added to each holding tank, and holding tank outlets that enable a selected tank interior to be emptied when the vacuum on a chamber is relieved;

b) a pair of suction lines for transmitting cuttings from the drill site to respective inlet openings of the holding tanks;

c) a power source for forming a vacuum within a selected one of the tank interiors and comprising a blower and an electric motor drive for powering said blower;

d) a rig vacuum tank having a pair of vacuum tank inlet fittings and a vacuum tank outlet fitting;

e) a pair of flow lines extending from the outlet fittings to the rig vacuum tank inlet fittings; and

f) control valves for controlling flow into the vacuum tank interior via the inlet fittings.

9. The apparatus of claim **8** wherein the suction lines include flexible hoses.

10. The apparatus of claim **8** wherein the valves enable a user to direct well cuttings to one of the holding tanks.

11. The apparatus of claim **8** wherein the valves continuously direct cuttings to one of the holding tanks so that the other holding tank can be emptied.

12. The apparatus of claim **8** wherein the vacuum tanks is positioned in between the power source and the holding tanks in a suction line so that the vacuum tank defines a second separator.

13. The apparatus of claim **8** wherein each of the holding tanks and power source are separate, transportable units.

14. The apparatus of claim **12** wherein the holding tanks and vacuum tanks are each mounted on separate transportable frames.

15. A method of removing drill cuttings from an oil and gas well drilling platform that uses a drill bit supported with a drill string and a well drilling fluid during a digging of a well bore, comprising the steps of:

a) separating drill cuttings from the well drilling fluid on the drilling platform so that the drilling fluids can be recycled into the well bore during drilling operations;

b) transmitting the cuttings to a materials trough having an interior;

c) suctioning the separated drill cuttings with first and second suction lines, each having an intake end portion that can be positioned at the materials trough;

d) transmitting the drill cuttings via a selected one of the suction lines to a selected collection tank of a pair of collection tanks in an alternating fashion so that one tank can be filling while the other tank can be emptied or replaced;

e) forming a vacuum within the interior of the selected collection tank using a blower that is in selective fluid communication with each tank interior via vacuum lines;

f) separating liquids and solids from the vacuum lines before said liquids and solids can enter the blower; and

g) valving the flow of fluid between the materials trough and the blower with a vacuum tank positioned in between the blower and the pair of collection tanks.

16. The method of claim **15** wherein in step "d", the collection tanks are filled and emptied in an alternating sequence.

17. The method of claim **15** wherein the flow velocity in the first suction line is about one hundred to three hundred (100–300) feet per second.

18. The method of claim **15** wherein liquids and solids are separated from the suction lines at the collection tanks.

19. The method of claim **15** wherein in step "e", the blower generates fluid flow in the vacuum lines of between about three hundred and fifteen hundred (300–1500) cubic feet per minute.

20. The method of claim **15** wherein the vacuum formed within the collection tanks is between about sixteen and twenty-seven (16–27) inches of mercury.

21. An oil well drill cuttings disposal apparatus comprising:

a) a pair of collection tanks for collecting drill cuttings to be disposed of, each said tank apparatus having an interior that allows material to be added to the tank apparatus, and outlets that enable each tank to be emptied;

b) a pair of primary suction lines for transmitting cuttings from the drill site to one of the collection tanks;

c) a blower for forming a vacuum within a selected one of the collection tanks;

d) a rig vacuum tank;

e) a pair of secondary suction lines for communicating between the interior of the collection tanks and the vacuum tanks;

f) the collection tanks defining separators that are positioned in between the primary and secondary suction lines for preventing the travel of solid and liquid matter from the collection tanks to the vacuum tank; and

g) the vacuum tanks having a pair of fittings for controlling vacuum generated by the blower so that a vacuum can be generated in either of the collection tanks so that the drill cuttings can be vacuumed to one collection tank or the other in alternating fashion.

22. The apparatus of claim **21** wherein the suction lines are flexible hoses.

23. The apparatus of claim **21** further comprising a flow control apparatus for directing well cuttings to a selected one of the collection tanks at a time.

24. The apparatus of claim **23** wherein the flow control apparatus continuously directs cuttings to one collection tank or the other so that cuttings can be continuously vacuumed.

25. The apparatus of claim **21** further comprising a valve associated with each collection tank for directing vacuum to one collection tank or the other.

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